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WHAT'S IN A WARM-UP? A PRELIMINARY INVESTIGATION OF HOW EUROPEAN DRESSAGE RIDERS AND SHOW JUMPERS WARM-UP THEIR HORSES FOR TRAINING AND AT COMPETITION.

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Abstract

Equestrian sports such as dressage and show jumping cause physical and physiological stress on the horses' musculoskeletal structures, which can lead to decreased performance and injury. Warming-up prior to intense exercise can increase utilisation of the aerobic pathway, increase performance and decrease injury risk. Whilst duration of equestrian warm-up regimes has been reported, details of which gaits and skills related tasks, such as jumping and lateral movements, riders elect to use have not been evaluated to date. The purpose of this study was to understand dressage and show jumping riders' decision-making when warming up at home and prior to a competition. Surveys (dressage: 39 questions; show jumping: 41 questions) were distributed online via social media. Mann Whitney U tests identified significant differences in warming up practice between dressage and show jumping riders. Most riders reported that a warm-up was beneficial for getting the horse ready for work, increasing responsiveness to aids, enhancing suppleness and relaxation, and decreasing injury risk. Both dressage and show jumping riders typically warm-up between 10-20 minutes. While dressage riders use the walk as their main warm-up gait, show jumpers preferred the trot. Both dressage riders and show jumpers incorporate technical skills in their warm-up such as lateral work, and quick transitions (when riders change gait for only few strides before changing again). Show jumpers include 4-10 jumping efforts, using different fence types. During a competition most dressage and show jumping riders agreed that factors such as perceived stress level of both the horse and rider, crowdedness of the arena, arena footing and size, as well as time allocated by the venue, were important factors that could impact the duration and content of their warm-up routines. Both groups of riders considered horses were sufficiently 'warmed up' when they were responsive to the aids and felt supple and relaxed.

Keywords: warm-up, Show jumping, Dressage, competition, equestrian sport, rider

No conflicts of interest relate to this work.

Introduction

Equestrian sports such as dressage and show jumping cause physical and physiological stress on the horses' musculoskeletal structures, which can lead to decreased performance and injury. (Williams, 2013a). As exercise intensity increases, the horse's heart rate and respiratory rate increases, lactate acid is produced and starts to accumulate in the muscles (Lekeux, 1991; Munster, 2013). To ensure optimal performance, undertaking a warming-up regime before intense exercise is acknowledged as an effective way to lower the risk of injury and increase performance in human athletes (McGowan, 2015). The same applies to equestrian sport, where both the horse and rider should complete a pre-competition warm-up to prepare them for the demands of competition (Tranquille, 2014; Williams 2013a). In horses, an efficient warm-up regime has been shown to increase the use of the aerobic metabolic pathway resulting in lower heart rates and respiratory rates during subsequent competition, diminishing glucose expenditure as well as reducing lactic acid accumulation in the muscles, delaying the onset of fatigue and providing a potential performance advantage over horses which have not been warmed up adequately (Mukai, 2010; Mukai, 2008 Jansson, 2005; Geor, 2000; Tyler 1996). However, despite this and the routine use of warm-up regimes in equestrian sport, limited studies have evaluated what constitutes an 'ideal' warm-up for different disciplines, horse experience, training level, fitness or how different environmental factors influence the warm-up.

Previous studies have shown that warm-up duration varies between equestrian disciplines and countries. Show jumping (SJ) warm-up regimes are reported to vary between 5-10 minutes (Dyson, 2018), 12-27 minutes (Tranquille; 2014) and 4-63 minutes (Chatel et al, in press). In contrast dressage (DR) warm-up regimes tend to be longer and are reported to be on average 16 minutes (Walters 2008), 29 minutes in the UK (Murray, 2006) and 60 minutes in Germany (Lindner, 2002). Whilst duration of equestrian warm-up regimes has been reported, details of which gaits and skills related tasks, such as jumping and lateral movements, riders elect to use have not been evaluated to date. For human athletes, it has been recommended that an efficient warm-up regime should integrate a rehearsal of the skills about to be performed to maximize the readiness of the body, by activating and recruiting the muscles required to execute them (Altavilla, 2018; McCrary, 2014). Therefore, dressage warm-up regimes should include practice of the movements and patterns required in the dressage test horses are expected to perform. Likewise show jumping horses should jump obstacles during their warm-up to prepare them for competition. Prior to competition, riders are responsible for deciding which tactics are used within the horse's warm-up (Williams, 2017). Riders' knowledge, skills and experience can therefore, influence how well the warm-up prepares the horse to perform at their best (Williams, 2017; Wolframm et al., 2008). Despite horse riders being observed during their warm-up regimes and elements of the routines being analysed, rider decision-making such as duration of the warm-up, gaits used when planning and implementing warm-up regimes in DR and SJ has not been evaluated to date. The aim of this study was to identify what factors influence SJ and DR riders' decision making when planning warm-up regimes, both for exercising their horses at home, and at competitions.

Materials and Methods:

Participants

Participants were recruited online via the sharing of a link to the survey on social media (Facebook®), on selected French equine-related groups including but not limited to cheval annonce PACA, and conseils et astuces cheval. The survey invitation was targeted as widely

as possible to include novice, amateur and professional riders, competing at any level in either show jumping or dressage, who were over 18 years of age. The survey was anonymous and no personal data were collected.

Survey Design

The study was designed as an online questionnaire (Survey Monkey®) with a total of 39 questions for dressage (DR) riders and 41 questions for show jumping (SJ) riders. The first seven questions were common for both SJ and DR riders and were multiple choice questions related to the respondents age, and nationality as well as their equestrian life and experiences. The survey was then divided into discipline specific questions on warm-up routines. The dressage survey consisted of three open questions, ten likert questions and 26 multiple choice questions. The survey for SJs consisted of three open questions, ten likert questions and 28 multiple choice questions; the two additional questions for SJ riders related to using jumping within warm-up regimes. Each participant could skip any question at any time. The three open questions for both SJ and DR included asking respondents to identify their key reasons for performing a warm-up, what factors affected their warm-up routine at a show, and how they knew their horses were sufficiently warmed up. The survey was divided into three parts:

- 1) Warm-up routine at home: respondents were asked on their perception of warming up, its use, the duration and composition of their routine;
- 2) Warm-up at competitions: respondents were asked about their warm-up routine at shows, the factors that could impact them; and;
- 3) Warm-up routine factors: respondents were asked about warm-up routines with different horses depending on their age and in different climates.

Ethical approval was granted by Hartpury University Ethics Committee.

Data analysis

The data collected using Survey Monkey® were exported into Microsoft Excel Version 2019 (IBM, New York, USA) and then analysed using Statistical Package for the Social Sciences (IBM SPSS Version 26; New York, USA). Data met non-parametric assumptions therefore, a series of Mann Whitney U tests were used to identify if differences occurred in the warm-up regimes between show jumpers and dressage riders. Significance was set at $P < 0.05$. A grounded theory approach was used to identify and rank the frequency of key themes within the open questions.

Results

Respondents

A total of 257 riders completed the survey. The majority of respondents (96.9%, $n=247$) were female and held an equestrian qualification such as teaching certificates or degrees awarded by an equine college or university (65.9%, $n=170$). The most common age range represented (51%, $n=131$) was 21-30 years old (Figure 1). All of the respondents were from Europe. Sixty percent ($n=155$) of the respondents usually warmed up independently, 28.9% ($n=69$) warmed up with a certified coach, 12.1% ($n=31$) warmed up with another rider who was not certified as a coach and 0.8% ($n=2$) rode with someone holding no teaching qualifications. Respondents were evenly distributed comprising 51.4% ($n=132$) dressage riders and 48.6% ($n=125$) show jumping riders. The majority of riders (87.2%, $n=225$) had started horse riding over 10 years ago, with

the majority of these also experienced in their discipline: 60.8% (n=76) specialised in dressage and 59.1% (n= 55) specialised in show jumping for over 10 years.

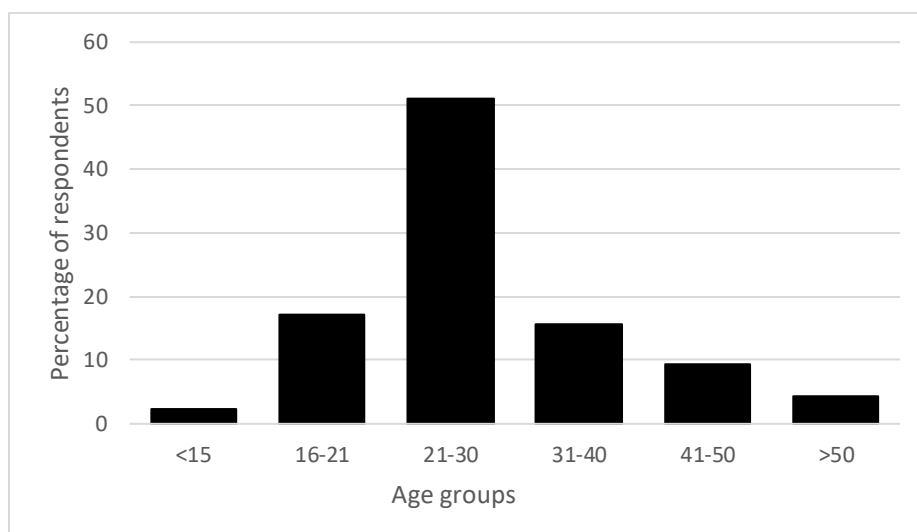


Figure 1: Age profile of respondents

Reason for performing a warm-up

No significant differences were found between how show jumping and dressage riders warmed up their horses ($P>0.05$; Figure 2). Respondents identified the three main functions of the warm up for DR were to prepare the horse physically for work (warm up muscles, tendons and joints), to get the horse reactive to the rider's aids and to increase suppleness. SJ riders reported they also used the warm up to prepare the horse's musculoskeletal system physically for work, to get the horse reactive to the rider's aid and to decrease injury risk. Only 2% of DR and 6% of SJ said that warming up could increase performance, and only 1% of DR and 3% of SJ felt warm up could decrease recovery time post exercise.

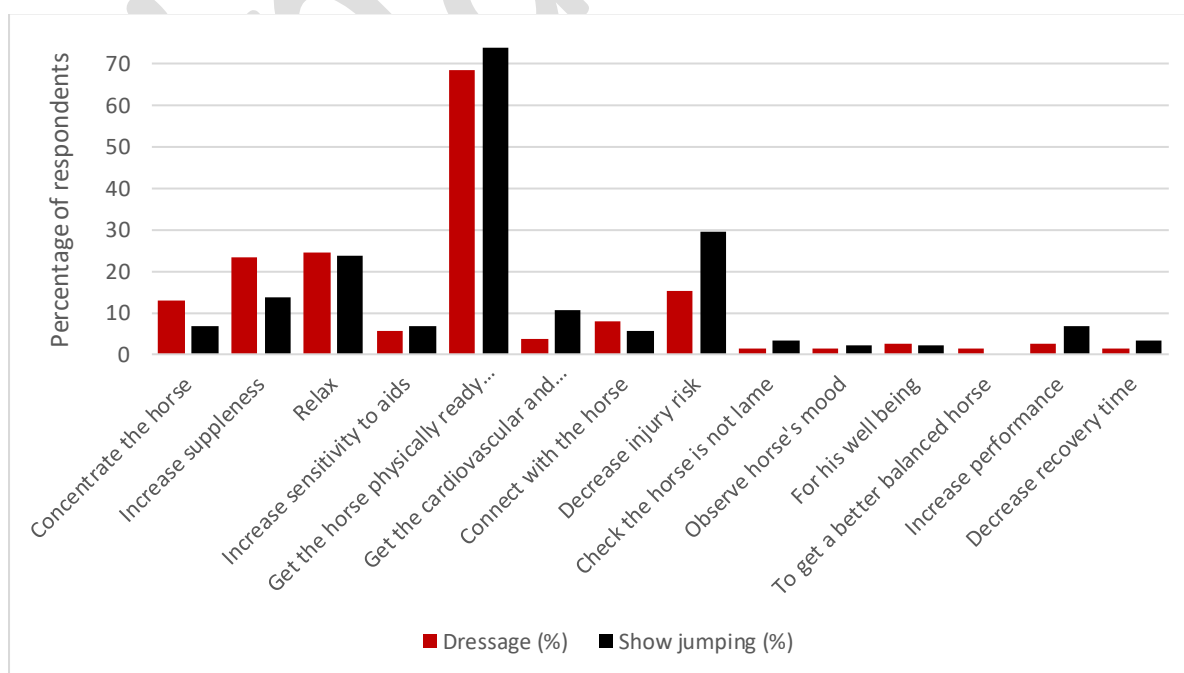


Figure 2: Riders key reasons for warming up in dressage and show jumping

Warm-up regimes: at home when training

Few riders (DR: 23%, n=30, SJ: 30%, n=38) used a fixed warm-up regime when training at home. Thirty nine percent (n=51) of DR and 21% (n=26) of SJ riders stated warm-up length should depend on the horse, however, the optimum length for the warm-up did not vary between disciplines (Mann Whitney U: 1917.5, $P>0.05$; range DR and SJ: 10-20 minutes). The majority of DR and SJ riders, 79.3% (n= 69) and 60.9% (n=56) respectively, hand walked their horse before getting on to warm up. Once mounted, most riders (DR: 75.9%, n= 66, SJ: 80%, n=72) started their warm-up allowing the horse to walk on a long rein. Within the warm-up, most riders (DR: 98%, n=128, SJ: 99%, n=125) reported they warmed up their horse symmetrically, spending an equal time on both reins. Differences between the time spent in each gait during the warm-up varied between disciplines, however, these differences were not significant ($P>0.05$; Figure 3). DR riders used the walk as their main warm-up gait (65%, n=56) while SJ riders reported using the trot most (46%, n=41).

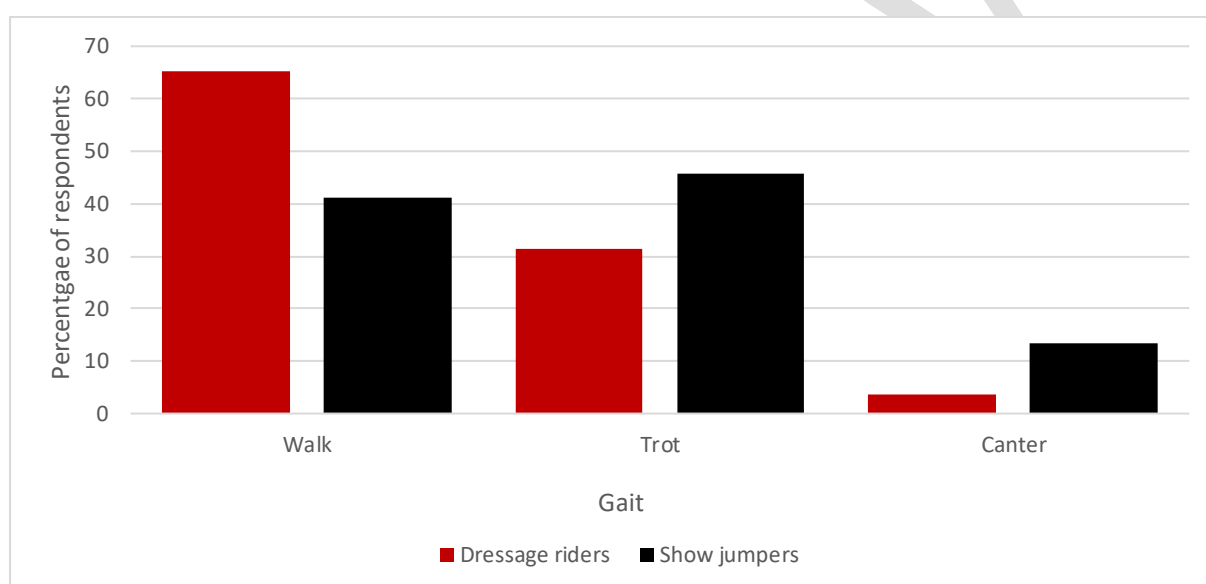


Figure 3: Gaits used by dressage riders and show jumpers for warming up their horses at home

Skills practice was incorporated into both DR and SJ warm-up regimes with riders in each discipline using movements such as lateral work, frequent upward and downward transitions of gait, and transitions within a gait to prepare the horse for training or competition (Figure 4). The majority of SJ riders (76.1%, n=70) considered jumping as an important component of their warm-up. The type of fence used within the warm-up varied with 60.9% (n=56) using cross poles and 31.5% upright fences (n=29).

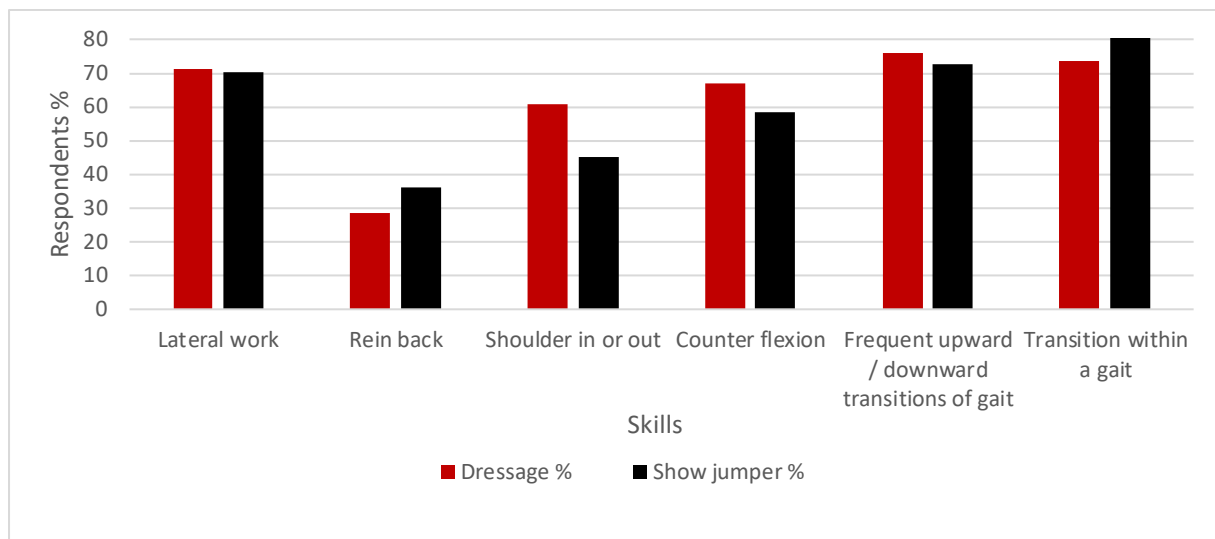


Figure 4: Skills used by dressage riders and show jumpers to warm-up their horses

Riders were asked if the same warm-up routine should be used when riding different horses, with only 30% of SJ (n= 27) and 23.2% (n=20) agreeing or strongly agreeing this was the correct approach. Few riders (DR: 31%, n=27, SJ: 22.8%, n=21) agreed or strongly agreed that a young horse (6years old and under) should be warmed up for longer than a mature horse. However, more riders felt it was important that horses over 16 years old should be warmed up for longer than a mature horse (6 to 15 years old) (DR: 56%, n=49, SJ: 55%, n=50). Lunging prior to riding was considered an efficient warm-up method for 52.9% of DR (n=46) and 44.6% of SJ (n=41). Increased dressage riders (72.4%, n= 63) compared to show jumping riders (47.8%, n=44) agreed that a warm-up routine should be modified depending on the time of the year, with 21.8% (n=20) of DR and 23.9% of SJ (n=22) agreeing that a horse ridden in the morning should be warmed up for longer than a horse scheduled to be ridden later in the day, regardless of if the horse was stabled or at pasture prior to work.

Warm-up regimes: prior to a competition

Approximately nine percent more DR riders (54.2%, n=46) than show jumping riders (45.6%, n=42) agreed or strongly agreed that using the same warm-up routine at home or at a show was beneficial. Show jumping and dressage riders reported different external and internal factors that could impact their warm-up routine (P=0.04, Figure 5). Both dressage and show jumping riders agreed that the crowdedness of the arena and the time allocated in the warm-up arena are key factors which impact how they chose to warm up. Interestingly, 3.5% (n=3) of dressage and 1.2% (n=1) of show jumping riders responded that nothing would impact their routines. Before entering the show ring, 48.9% (n=45) of SJ stated they use between 7 and 10 fences to warm-up, 41.3% (n=38) said they jumped 4 to 7 fences, 8.7% (n=8) jumped less than 4 fences and 1.1% (n=1) did not jump before entering the show ring. Forty four percent of show jumpers (n=40) and 50.6% of DR riders reported never using a previous class as a warm-up at a show before their main event. The riders who did use a previous class as a warm-up for subsequent competition, reduced the length of their horse's warm-up for the second class (DR: 77%, n=66, SJ: 71%, n=65).

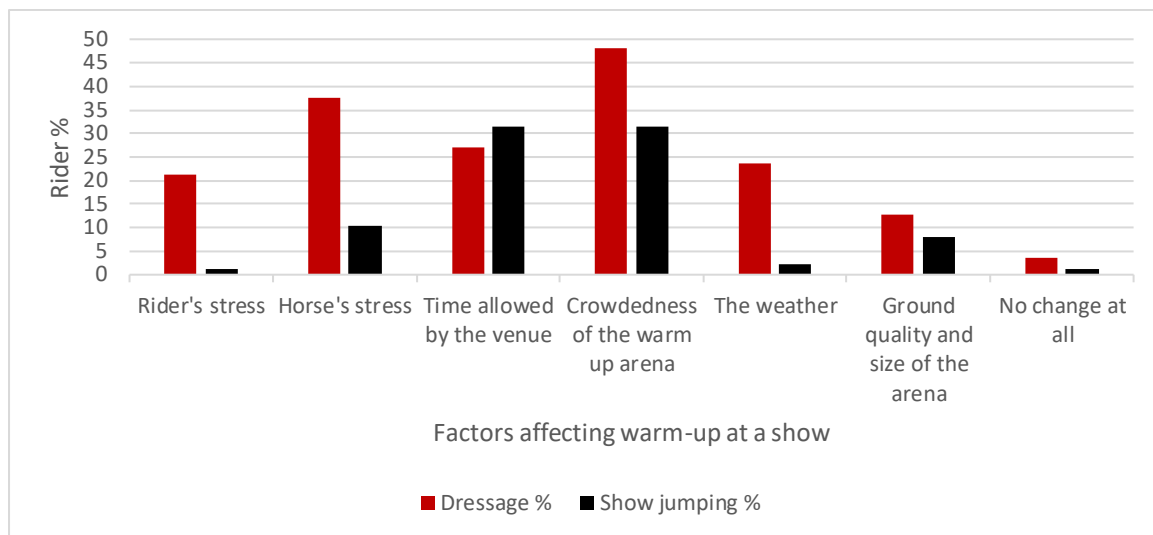


Figure 5: Internal and external factors that can impact the warm-up routine of dressage and show jumping riders prior to a competition

When is the horse warmed up?

Both DR and SJ riders agreed that a warm-up should be between 10-20 minutes in length. Once the horse was responsive to the rider's aids, more supple and relaxed, most riders considered their horses were sufficiently warmed up for competition (Figure 6).

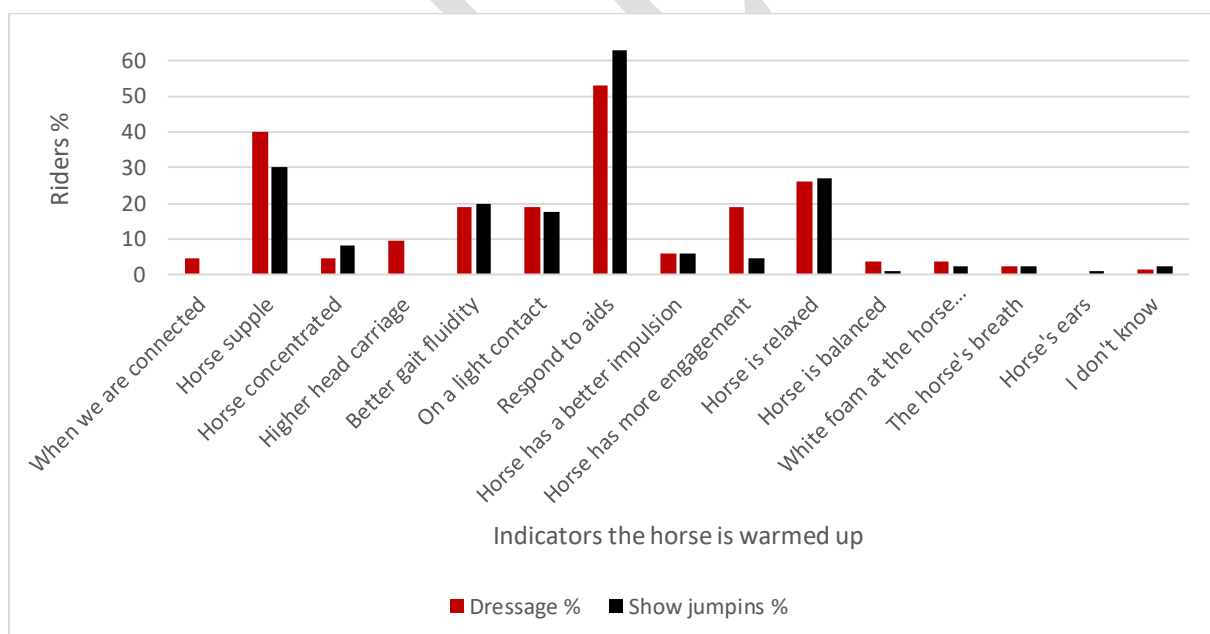


Figure 6: Riders perception of characteristics which indicated their horses were warmed up.

Discussion

The main goal for performing a warm-up is to increase body temperature which will increase muscle temperature, and increase blood flow and oxygen intake by the muscles, making the body less susceptible to injury. A higher body temperature will also increase the sensitivity of nerve receptors as well as the speed of nervous impulses (Kenney et al, 2011; McGowan, 2015).

Riders surveyed felt that a warm-up should be used to prepare the horse physically for work. Riders reported they used the warm-up to get the horse ready for work, to warm up the horse's muscles, tendons and joints, to get the horse more reactive to the aids, to increase suppleness and to decrease injury risk in preparation for exercise. Surprisingly, most riders did not think about the warm-up as performance enhancing despite using key performance attributes such as response to their aids to judge the efficacy of the warm-up. Visser (2008) observed that riders preferred to ride horses that are more responsive to their aids. However, whilst responsiveness may enhance performance, it could relate to the horse's prior skill level, training or rider skill rather than indicating the horse's physical and/or mental preparedness for the subsequent competition (Williams, 2013b). Using only responsiveness to the rider's aid as the sole indication that the horse is warmed up, could lead to a shorter warm-up duration than is actually required to prepare the horse's body systems for high intensity exercise or specific skilled movements, potentially increasing injury risk and reducing competitive success. Further studies determining how different warm-up regimes prepare the horse physically and mentally for competition are needed to fully evaluate what constitutes an efficient warm-up.

Both dressage and show jumping riders agreed that a warm-up routine should last between 10-20 minutes which agrees with the average length of warm-ups reported within show jumping competitions by Tranquille et al (2014; average 18mins) and by Chatel et al (in press; average eighteen minutes and fourty three seconds minutes) and within dressage competitions by Walters (2008; average 16 minutes), but is shorter than the average of 30 and 31 minutes reported for dressage warm-ups by Murray et al (2006), Williams et al (2008) and Lindner (2002). Few riders reported having a fixed warm-up routine when training at home, however, approximately half felt that using the same warm-up at home in competition was beneficial. Tranquille (2014) found that warm-up duration and time spent in each pace and rein did not vary within SJ riders on different days during a 'mock' competition. Our results suggest that the majority of SJ and DR riders demonstrate a preference to apply a flexible approach to their horses' warm-up in competition.

Equestrian sport is defined by successful horse-rider partnerships (Wolframm et al, 2013; Williams, 2017), with rider anxiety and confidence key determinants influencing competitive performance especially in non-elite riders (Wolframm and Micklewright, 2008). Wolframm et al. (2010a) also reported a trend for non-elite SJ riders to demonstrate increased mental disorientation during competitions, which would affect riders' capacity for effective decision-making and logical thinking. This combined with increased anxiety and reduced confidence would be detrimental to horse and rider performance. Therefore, adopting a fixed approach to warm-up regimes in training and competition could reflect a beneficial strategy to enable less experienced riders to manage their own performance with the aim to support the wellbeing of their equine partner. However, this method could also constrain performance, if riders are too rigid and take an inflexible approach in their warm-up. Adapting their horse's warm-up in response to factors beyond their control, such as weather and ground conditions at the competition venue, is also important to consider and could influence performance as well as injury risk (Williams, 2017).

Most dressage riders and show jumpers reported that they start their warm-up by walking the horse on a long rein (DR: 75.9%, n= 66, SJ: 80%, n=72). This approach allows the horse to soften and lower the head and neck, allowing the horse's back to move more freely (Rhodin, 2008). Dressage riders reported using the walk as their main warm-up gait. Observation of warm-up in DR competitions has also found horse and rider combinations spend the majority of their warm-up in walk (Murray, 2006). Tiel (1987) reported that walking, especially when

integrating the opportunity for the horse to stretch and flex the back muscles, will provide a beneficial start to a warm-up, facilitating suppleness and increasing muscle temperature. However, in order to prepare the horses' cardiovascular and musculoskeletal system ready for the work to be achieved, trot and canter should not be neglected from warm-up regimes by dressage or show jumping riders. The muscles of the horse used predominately in athletic exercise, such the longissimus dorsi, rectus abdominus, splenius, biceps femoris and gluteals have been shown to report higher peak activity in trot compared to walk (Crook, 2010; Harrison, 2012; Wakeling, 2006; Zsoldos, 2010a,b). Therefore, including trot within a warm-up regime could enable a more thorough warm-up of these muscles preparing them for the higher intensity exercise required in competition. For example, integrating time within rising trot during the initial phase of a horse's warm-up regime allowing the horse to stretch their head and neck, and flex the back could warm up the muscles, increase suppleness and allow the horse to relax.

Active warm-ups should mimic metabolic changes which will occur in the subsequent competition (McGowan et al., 2015), therefore, variable exercise intensities should be used within the warm-up to prepare the horse for optimal performance. During walking, equine heart rates average between 40-80 beats per minute (bpm), increasing to 80-120 bpm in trot, 120-160bpm in a medium intensity canter, 160-200 bpm in high intensity canter and 200-240 bpm in gallop are reported (Williams, 2017). Dressage competitions up to medium level rely on aerobic metabolism, with average heart rates of 102 and 107 bpm reported in elementary or medium level dressage horses respectively (Williams, 2008). Therefore, dressage warm-up regimes should predominantly work horses aerobically targeting increased flexibility and suppleness and preparing the horse for the movements and gaits required during the test. During a show jumping round, horses' should be working aerobically during flatwork with periods of anaerobic activity during jumping (Williams, 2013a, b). Average heart rates during show jumping shows have been reported from 109 bpm to peak values >180 bpm (Barrey, 1993; Lekeux 1991). Since trot work increases the horses cardiovascular input, warms up muscles symmetrically, whilst minimizing energy expenditure, glycogen store depletion and lactic acid production (Lekeux, 1991), it could be suggested as a suitable gait to facilitate aerobic warm-up for competition. However, a key aim of an ideal warm-up regime is to prepare the athlete for the range of movements required in the competition. Therefore, as show jumping rounds occur in canter, an optimal warm-up should also integrate this gait. The application of specific warm-up routines has been shown to be more efficient compared to passive or general warm-up routine in human athletes (Feigenbaum, 2005) supporting this approach combined with the integration of key skill attributes, such as jumping or specific dressage movements, within equine warm-up regimes.

Dressage riders reported practicing the skills required in dressage tests when warming up for training at home or prior to a show. These skills included lateral work, shoulder in / out, quick transitions, counter flexion and transitions within a gait. Accurate execution of these movements will also promote increased suppleness and responsiveness of the horse to the rider's aids. Show jumping riders surveyed reported including dressage movements in their warm-up, which are not required for competitions. Dressage movements could be used to increase suppleness which is required during a show jumping course when the horse requires to execute quick and sharp turns (Williams, 2013b). Dressage movements could also be used to increase reactivity to the aids which show jumpers value as a measure which demonstrates a horse is warmed up appropriately. Show jumping riders also integrated jumping into their warm-up which would support subsequent competitive performance, jumping between 4-10 fences. Previous studies have reported wider variation in the number of fences used in show jumping warm-up, ranging between an average of 9 (Tranquille et al., 2014) and 13 fences

(Chatel et al., in press). The specific number and type of fence selected during warm-up regimes should be tailored to the individual horse and their experience, however, as jumping reflects high intensity, anaerobic exercise, riders should avoid over-jumping in a warm-up as this could contribute to early onset of fatigue in competition and be performance limiting (Williams, 2013a).

In this study, both show jumpers and dressage riders reported warming up their horses equally on both reins. Whilst the riders surveyed may perceive they achieve equality on each rein within their warm-ups, evidence suggests that practically this is not always correct. Tranquille et al. (2014) found elite show jumping combinations warmed up more on the left rein than on the right. Show jumping course designers aim to test the skill of the horse and the rider through the courses they design (Williams, 2013b). Courses will normally include changes of direction, therefore, to prepare the horses warming up equally on each rein should be advantageous. However, a prevalence for a specific lateral dominance (handedness) is well established in horses (Williams, 2011), therefore, through training the goal of the rider is often to achieve a symmetrical and balanced horse. Increased symmetry has been associated with superior performance in racehorses (Manning and Ockenden, 1994) and eventing horses (Lesniak, 2019), whilst asymmetric loading is connected to an increased injury risk in the equine athlete (Williams, 2011). In contrast the role of the warm-up is to prepare an individual horse for the performance demands in competition in essence to create a supple, flexible and engaged athlete enabling optimal performance. If this is to be successful if a horse has an inherent (e.g. a favoured rein) or an acquired lateral (e.g. due to previous injury) preference then the rider should adapt the time spent on each rein to ensure the warm-up regime is tailored to the individual needs of that athlete rather than spending an equal duration on each rein.

When making a decision for their horses, the riders have to consider all the internal and external factors that can affect their own, their horses and the partnerships performance (Williams, 2017). Across disciplines, riders reported that they reduced warm-up duration when horses had already competed on the same day. These findings concur with Chatel et al. (in press) who also reported show jumpers warmed up for a shorter time when they had competed in the class just prior to their next one. Each rider has the responsibility to not only make the best decisions to promote optimal performance but also to protect horse health and welfare when selecting the warm-up approach to be used. Experience of the rider will impact on decision-making skills which in turn will influence the performance of their equine partner (Wolframm, 2010b; Williams, 2017). Riders perceived that stress (in themselves or the horse) impacted warm-up routines at shows. Increased anxiety and reduced confidence have previously been reported to correlate with decreased performance in both show jumpers and dressage riders (Wolframm, 2010a, b). Ford et al. (2017) define sport-related stress or anxiety as ‘a trait and/or state-like response to a stressful sport-related situation, which the individual perceives as potentially stressful, resulting in a range of cognitive appraisals, behavioural responses, and/or physiological arousals’. Whilst a low level of anxiety could represent anticipation prior to competing, generally anxiety is considered to result in reduced athletic performance and a higher risk of injury (Ford et al., 2017). The integration of sport psychology approaches including cognitive behavioural therapy (CBT: cognitive-change methods that employ self-talk, imagery and covert rehearsal) and / or applied behaviour analysis (ABA: focusing on the antecedents and consequences of behaviour relative to positive reinforcement, negative reinforcement and punishment contingencies) could help minimise the impact of, or prevent anxiety in riders from negatively impacting performance (Luiselli, 2016; Wolframm and Micklewright, 2008). Exploration of strategies to reduce equine anxiety at competitions would also be beneficial to enhance performance across the horse-rider dyad.

Horse age influenced how riders in this survey decided to warm-up their horse. There was a trend for increasing age to correspond in a longer warm-up regime in both dressage and show jumping horses. Older horses encounter physiological changes such as lower aerobic capacity and maximal heart rates, decreased ability to thermoregulate, musculoskeletal changes and endocrine alterations (McKeever, 2016). All of these can cause poor performance as well as lead to horses requiring longer recovery periods post competition. It is therefore, essential for the older equine athlete to be warmed up appropriately. A longer and lower intensity warm-up can enable the older horse to slowly build up core temperature, allowing the muscles to gently warm up, increase oxygen uptake and enhance the aerobic pathway without depleting the glycogen stores (Stachurska et al, 2018). Riders should also consider the environmental conditions: weather, temperature and humidity when deciding their warm-up routines. High temperatures combined with increased humidity will reduce the ability of the horse to thermoregulate efficiently (Marlin, 1998). Whilst in cold weather, core temperature will take longer to rise especially in the limbs, again potentially affecting performance (Wallsten, 2012).

The results of our survey suggest that riders judge when a horse is warmed based on subjective feelings and the ability to perceive key signs from the horse, however, this approach requires experience, knowledge and the correct interpretation of the horses' responses.

Rider perception can also vary depending on individual horse and rider partnerships, rider arousal level and education (Williams, 2013a, b; Wolframm et al., 2010a,b; Marlin et al., 2018). The integration of performance analysis techniques to record and monitor key data from within warm-ups such as time spent in each gait, on each rein, specific movements performed, speed and heart rate could support riders in applying a more evidence informed approach to preparing their horse for exercise. Further research is required to understand how passive and active warm-up regimes are applied in practice by riders across different disciplines and levels, as well as comparing riders' perception of how they believe they have warmed up to what actual warm-up routines consist of.

Limitations of the study

Although a wide range of factors related to warm-up regimes were considered, the study had some limitations. Additional information which could influence rider decision making and warm-up regimes could have been included related to rider and horse experience and competitive level. Questions were designed with an open 'other' comment box to capture rider specific factors, but the use of interviews or focus groups may have encouraged wider discussion. Data were also self-reported therefore, the data collected depended on respondents' memory recall and honesty. Riders' retrospective memory in this study could be vague, lack specific details or be disorganised (Koss et al., 1996) which could affect the accuracy of their memory recall. The survey was distributed via social media which may have limited the demographic of participants. Riders mainly aged 21 to 30 years old completed the survey; increased numbers of older or more experienced riders may have resulted in different results. Future studies combining observation of horse and rider combination warm-ups in competition and during training, with subsequent reflection and evaluation of warm-up content and work load are recommended, in order to develop a more accurate appraisal of factors which influence dressage and show jumping riders' decision-making in this essential precursor to exercise/competition.

Conclusion

Both dressage and show jumpers maintain that warm-up regimes should prepare the horse for work, increase responsiveness to the riders' aids, increase the horse's suppleness and promote relaxation to enhance performance and decrease injury risk. Warm-up duration used was similar for both dressage riders and show jumpers averaging 10-20 minutes. Dressage riders used walk as their main warm-up gait, whilst show jumpers preferred trot. Across both disciplines, riders included technical skills in their warm-up such as lateral work, transitions and jumping. During a competition approximately half of dressage and show jumpers surveyed agreed that using the horses' usual warm-up routine was beneficial. Riders felt factors such as the stress level of both the horse and rider, crowdedness of the arena, arena size and surface as well as time allocated by the venue were important factors that could impact their warm-up routines. Both show jumpers and dressage riders considered horses were warmed adequately using subjective measures likely to vary between riders: the horse's responsive to the aids, when the horse felt supple and relaxed. Future research is warranted to investigate if rider recall of warm-up regimes matches the duration and activities included in these, in practice.

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